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INTRODUCTION

The lifestyle and culture of the ancient Maya of Mesoamerica have been studied for over five centuries. The Spanish explorers and priests who first encountered the Maya in the late 15th and early 16th centuries were also the first members of the Western world to document their daily, seasonal, and annual activities. At the time of contact, the Maya possessed volumes of glyphs recording their cultural, religious, political, and social history. Unfortunately, very few of these volumes survived the colonization of Mesoamerica. It is from the remaining Maya codices and the books of Chilam Balam, early Spanish ethnohistoric accounts, the material culture remains of the archaeological record, modern Maya oral history, and ethnographic reports on modern Maya groups that we can attempt to reconstruct and understand ancient Maya life.

The early days of Maya archaeology focused on the large ceremonial centres with their elaborate architecture and iconography. The examination of the political, economic, social, and religious significance of these centres was the predominant area of research in the 19th century and the first half of the 20th century. It was only during the second half of the 20th century that research greatly expanded to include demography, social status, health and nutrition, and diet and subsistence economy.

It was assumed early on in Mesoamerican archaeology that maize was the main subsistence item of the cultural groups that inhabited this region throughout prehistory. As such, until the 1970s relatively little attention was devoted to the systematic collection and analysis of faunal remains recovered during the archaeological excavations of Maya sites (Clutton-Brock and Hammond 1994:819). Lists of the economically significant species were merely compiled along with the site reports.

This lack of interest in faunal remains may have resulted from the assumption that animal protein was only a minor constituent of ancient Maya diet, and also from the relative scarcity of faunal data (Clutton-Brock and Hammond 1994:819). Preservation is one of the most important factors to consider when examining archaeological material in the Maya region. The humid environment of the tropical rainforests in this area and the highly acidic soils are detrimental to organic remains. It is thus very difficult for archaeologists to attempt to reconstruct prehistoric cultural activities at any given site.

Another important factor that must be examined is the excavation strategy employed during archaeological investigation. The director of any archaeological project has a specific

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research question in mind and tailors his/her excavation methodology and strategy accordingly. These decisions reflect the site and soil sampling methods, tools employed (i.e. shovel versus trowel), screening method, screen size, and time devoted to field identification and analysis. All of these factors greatly influence the recovery of archaeological material from a site.

Within the past three decades, zooarchaeologists have begun to analyze the faunal collections from sites excavated during the early years of Mesoamerican archaeology, and have been involved in the planning and excavation of recent projects (Clutton-Brock and Hammond 1994). This work has resulted in an increased recovery of faunal data from Maya sites and interpretations of these data that reflect the lifestyles of the ancient Maya. In addition, prehistoric Maya writings, art, and ceramics, and ethnohistoric accounts document a variety of faunal groups that contribute to the diet and subsistence of the Maya, and also possess symbolic, ritual, ceremonial, ideological, and cosmological significance.

The archaeological record also contributes to the understanding of human-faunal interactions in the Maya world. Hamblin (1984) summarized the major classes of information that can be obtained from archaeological faunal analysis. These include:

1) food-gathering preferences, patterns, and techniques;
2) butchering and other food-preparation practices;
3) environmental or ecological implications;
4) religious and ceremonial uses of animals;
5) animal bone as a source of tools and other artifacts;
6) evidence of domestication; and
7) indications of prehistoric trade.

It is thus apparent that faunal remains recovered from archaeological sites can provide insight into a number of different aspects of ancient Maya life.

An important feature of Maya culture is respect for the surrounding environment and the plants and animals within it. Both ancient and contemporary Maya groups have demonstrated an intricate relationship with the environment that has enabled them to utilize the diversity of resources it offers. The interactions between humans and animals that comprise this complex relationship are the focus of this paper, and can take many different forms. These encounters can be wholly spiritual, psychological, or physical, or a combination of these. These encounters can be with a single animal, or with groups of varying sizes of animals, and may include more than one animal type. The following discussion will focus on the interactions between the ancient Maya and three animal types: deer, turtles, and dogs. It is beyond the realm of this paper to examine the relationships between the ancient Maya and all of the faunal classes they exploited. The three animal types examined in this paper, two mammals and a reptile, should illuminate issues common to most, if not all, Maya-faunal interactions.

The examination of human-faunal interactions can occur on many different levels and from many different angles. The areas of interest in the present study include:

1) the symbolic significance of deer, turtles, and dogs in the Maya culture;
2) the ceremonial or ritual utilization of these animals as evidenced in the archaeological record;
3) the procurement and processing methods associated with deer, turtles, and dogs;
4) the contribution of these animals to ancient Maya diet, as evidenced by isotopic analyses and by their presence in the archaeological record;
5) the identification of the spatial significance of deer, turtles, and dogs at coastal versus inland sites; and
6) the identification of the temporal significance of the use of these animals from the Preclassic to Postclassic periods.

Through an examination of these research areas, the importance of the study of human-animal interactions in the field of Mesoamerican bioarchaeology will be emphasized.

SOURCES OF DATA

The data presented in this paper were collected from a number of different resources, all of which are secondary, and in some cases tertiary, in nature. These include ethnohistoric and ethnographic accounts, archaeological site reports, isotopic analyses of human remains, and examinations of ancient Maya art, glyphs, and ceramics. This variety of resources was employed in an attempt to examine the interactions between the ancient Maya and deer,

turtles, and dogs from as many angles as possible.

In this endeavour, it was necessary to limit the expanse of research to a relatively small sample of sites. This proved to be a very difficult task due to the inconsistency of reporting faunal remains from archaeological sites in the Maya region. Even when sites with faunal data components were found, the data presentation format greatly varied between sites. Some sites reported animal frequency as number of individual specimens (NISP), while others reported animal frequency as minimum number of individuals (MNI) represented in the sample. A few of the sites reported frequencies as both NISP and MNI, while others only reported animal frequencies as percentages of the total NISP and MNI recovered from the site.

Another factor to consider is the temporal distribution of the faunal remains at each site. One of the objectives of this paper is to determine if there are any trends in the interactions between the ancient Maya and deer, turtles, and dogs over time. Very few sites excavated in the Maya region to date present evidence of continual occupation from the Preclassic to the Postclassic periods. This is due partly to the ongoing nature of many of the archaeological projects being conducted. Thus, a greater number of sites must be examined in order to assess temporal trends of Maya-faunal interactions. For the purposes of this paper, a total of ten sites were selected. These sites are located throughout the Maya lowlands in both inland and coastal environments. They have been classified as follows:

TABLE 1: CLASSIFICATION OF INLAND VERSUS COASTAL SITES

INLAND SITES	COASTAL SITES
Altar de Sacrificios	Colha
Cahal Pech	Cozumel Island
Lamanai	Cuello
Seibal	Dzibilchaltun
Tikal	
Tipu	

Figure 1 illustrates the locations of these sites in Mesoamerica.

SYMBOLIC, CEREMONIAL, AND RITUAL SIGNIFICANCE OF DEER, TURTLES, AND DOGS IN THE WORLD OF THE ANCIENT MAYA

DEER

Ethnohistoric, ethnographic, and archaeological evidence illustrate the presence of two different types of deer in Mesoamerica from the prehistoric period to the present. These are the white-tailed deer (*Odocoileus virginianus*) and the brocket deer (*Mazama americana* and *Mazama gouazoubira.*). The brocket deer is represented by two different species, and will thus be referred to as *Mazama spp.* Ethnohistoric accounts cite the ancient Maya as preferentially exploiting the white-tailed deer, only hunting the brocket deer on rare occasions (Landa 1566). This is also illustrated by the lower frequency of the brocket compared to the white-tailed deer in the faunal data from all of the coastal and all but one (Tipu) of the inland sites examined in this sample.

FIGURE 1: Location of sites examined in this study.
Source: Powis *et al.*, 1999:365.

Ancient Maya codices and artistic renditions appear to associate deer with the elemental forces of life – sun and rain (Pohl 1983, 1990). The deer cult is connected to fertility, yearly renewal (the *cuch* rite), political inauguration, ancestor lineages, and agricultural security (Pohl and Feldman 1982; Pohl 1983, 1985, 1990). Deer are classified as a high status

feasting food, offered to the gods and consumed by the elites. Tozzer and Allen (1910:348) stated that "[Deer] is an important, perhaps the most important animal offering as a sacrifice to the gods."

The recovery of deer remains from ritual or ceremonial contexts has been documented at many sites throughout the Maya realm and during all temporal periods. Deer remains have been recovered from ritual or ceremonial contexts at every archaeological site considered in this study (Wing and Steadman 1980; Hamblin 1984; Pohl 1990; Wing and Scudder 1991; Stanchly 1995; Emery 1999; Shaw 1999). This is exemplified at Cuello where two deer mandible caches have been identified at the Late Preclassic level (Pohl 1985; Wing and Scudder 1991). Pohl (1985:140) noted the location of these caches along the east-west axis of Late Preclassic platform 34, and suggested their placement during the renewal of the platform (Figure 2).

The importance of the sacrifical deer haunch is illustrated in the Maya codices and Postclassic rituals books, a few images of which are depicted in Figure 3. This is best demonstrated at Seibal where Pohl (1985, 1990) noted a predominance of left elements, especially limb bones.

FIGURE 3: The Sacrificial Deer Haunch. Source: Tozzer and Allen 1910: Plate 31.

TURTLES

The archaeological record, in conjunction with ethnographic analyses, provides evidence of numerous turtle species in Mesoamerica. A total of twelve different species have been identified from the faunal remains of the ten sites within this sample. These have been grouped into the five families presented in Table 2.

The symbolic, ritual, and ceremonial significance of the turtle in the Maya world does not appear to depend on either the family or species of turtle. Pohl (1983) noted the representation of the turtle in ceremonial architecture and animal effigy figures, while Lange (1971) and Carr (1985) suggested the use of turtle carapaces as musical rattles and drums in certain ritual and ceremonial contexts, based on the presence of these instruments in the archaeological record.

TABLE 2: TURTLE SPECIES CLASSIFIED BY FAMILY

TURTLE FAMILY	TURTLE SPECIES
DERMATEMIDAE (River turtle)	*Dermatemys mawii*
KINOSTERNIDAE (Mud and musk turtles)	*Staurotypus triporcatus* *Kinosternon cruentatum* *Claudius angustatus*
CHELYDRIDAE (Snapping turtles)	*Chelydra serpentina*
EMYDIDAE (Box and freshwater turtles)	*Trachemys scripta* *Pseudemys scripta* *Chrysemys scripta* *Geomyda pulcherrima* *Terrapene mexicana* *Rhinoclemmys areolata*
CHELONIIDAE (Sea turtles)	*Chelonia mydas*

Ancient Maya codices and ritual books associate the turtle with rain and water symbolism and wealth (Thompson 1970:71,187). The turtle also plays a significant role in the

Maya creation story as is evidenced in Maya texts such as the Popol Vuh, as well as in inscriptions on sixth-, seventh-, and eighth-century Maya stone monuments (i.e. Quiriga Stela C) (Freidel *et al.* 1993). Freidel *et al.* (1993:66, 80, 283) recounted this story:

> The redressed Maize God was carried to the place of Creation in a canoe. There he emerged from his cracked turtle carapace, with the help of his sons, the Hero twins. He set the three stones of the hearth and helped his companions in Creation draw the images of the constellation in the sky. Orion is the turtle and the three stars on the back of the turtle were placed in the exact pattern of Orion's belt (Figure 4).

Evidence of ceremonial and ritual use of the turtle extends temporally and spatially across the Maya lowlands. Turtle remains were recovered at many of the archaeological sites in this sample. The most notable of these was Hamblin's (1984) study of the faunal remains from Cozumel Island. She noted that turtle remains predominated in burial and ceremonial/administrative contexts across the sites on this island. Perhaps these were sacrificial offerings to the gods, as suggested by Landa (1566).

Thompson (1970:278, 279) discussed the importance of the turtle in the *bacab* cult, which has been traced back to the Classic period. The *bacabs* are seen wearing turtle carapaces and conch shells, or emerging from conch shells (Figure 5). The *bacabs* have been described as actors on the Maya stage, with very strong influences on the luck of the year. They supported the skies, and there are hints that they may have dwelled beneath the earth, also supporting it (Thompson 1970:280). The *bacabs* were closely associated with bees and with Maya world directions and colours. They often disguised themselves as opossums, and may also have personified stars or constellations (Thompson 1970:280). The *bacabs* held important roles in many ancient Maya spiritual and religious ceremonies and festivals.

The *bacab* cult may have ties to Andrews' "cult of the sea" as discussed by Moholy-Nagy (1978:71). In her paper on the freshwater snail, *Pomacea spp.*, Moholy-Nagy (1978) described the Early Classic ritual association of freshwater snail, crocodile, and turtle remains at Tikal, Guatemala.

DOGS

Evidence from the archaeological record and ethnohistoric sources indicates that the domestic dog (*Canis familiaris*) was present in Mesoamerica from the Preclassic through the Historic periods. At least two different sizes of dog were present throughout Maya prehistory, noted ethnohistorically by Landa (Tozzer 1941) and in the archaeological record by Hamblin (1984), Pohl (1990), and Clutton-Brock and Hammond (1994).

White *et al.* (2001:103) outlined the importance of dogs to the existence of human life and the place of humans in nature. They discussed the Quiche Maya creation text, which describes the following traditional Maya beliefs of the treatment of dogs:

1) dogs need to be fed well in order for humans to survive;
2) the sacrifice of a dog allows humans a place on earth; and
3) sacrificed dogs can be brought back to life symbolizing regeneration.

White *et al.* (2001:103) stated that, "this ritual, mortuary, and feeding behaviour maintains, justifies, and renews the existence of humans on earth." For the ancient Maya, dogs were symbolic representatives of the elemental forces of life: fire and hearth (Nicholson 1971 and Thompson 1972, in White *et al.* 2001).

Maya art and traditional lore associates dogs with death, destruction, and the journey to the underworld (Hamblin 1984; White *et al.* 2001). Dogs are traditionally placed in the graves of their masters as messengers to prepare the path to the other world and to help ferry the soul of the master across the great underworld river (Thompson 1970:300; Hamblin 1984:117; White *et al.* 2001). Dogs are important symbols throughout the Maya life cycle, from birth to death, and even after. Their role as hunting and travelling companions appears to be carried on to the underworld (White *et al.* 2001:92).

Dogs, like deer, were one of the most important ritual animals in ancient Maya culture and were designated as a high status feasting food, evidenced in ethnohistories, Maya codices, ritual books, artwork, ceramics and the archaeological record. Landa (1566) described two contexts for dog sacrifice as performed by the Maya: the New Year's rites and the cacao rituals. During the New Year's rites, dogs are sacrificed in the place of humans, to perpetuate the idea of new beginnings and thus yearly renewal (Pohl 1983). In the cacao rituals, dogs "spotted with the colour of cacao" are sacrificed as offerings to the gods to ensure economic success (Landa 1566:164). Like deer sacrifices, dog sacrifices have also been associated with political inaugurations and the founding of new civic religious centres (Danien 1997, in White *et al.* 2001). Landa (1566) noted that the dog is the most common victim of sacrifice after humans. The heart is removed and burned, while the blood is used to anoint the idols; the remainder of the animal is consumed by the elites.

Wing (1978) and Hamblin (1984) noted the presence of dog burials in Postclassic ceremonial and administrative contexts on Cozumel Island, while Pohl (1983) identified dog burials in natural features associated with fertility and ancestor worship. The ritual and ceremonial use of dogs has been documented throughout the Maya lowlands, and seems to increase in importance during the Classic and Postclassic periods. Little, if any, evidence of ritual dog use has been documented in the Preclassic period, although dog remains abound in middens during this time (Pohl 1983).

SUMMARY

Except in distinct burial and cache contexts, it is often difficult to identify the ritual or ceremonial importance of faunal remains at Maya archaeological sites. It is clear, nonetheless, that deer, turtles, and dogs play a significant role in Maya ritual and ceremonial activities across the lowlands and throughout prehistory. These animals are identified as elemental symbols of life (sun, rain, water, fire, hearth, wealth, and fertility), which are incorporated in daily and annual activities. Each

of the sites examined in this study presents faunal evidence with some degree of ritual or ceremonial significance.

ANCIENT MAYA PROCUREMENT AND PROCESSING METHODS OF DEER, TURTLES AND DOGS AND THEIR ROLE IN THE SUBSISTENCE ECONOMY

DEER

Ancient Maya codices, ritual books, ceramics, and artwork illustrate the use of a variety of deer hunting strategies (Pohl and Feldman 1982; Pohl 1985, 1990; Carr 1996). Ethnohistoric accounts also discuss the strategies that were being employed at the time of Spanish contact (Landa 1566). The prehistoric Maya hunted deer with the use of nets, blowguns, spears and atlatls, snares, and deadfall pits (Pohl and Feldman 1982; Pohl 1985,1990; Carr 1996; White *et al.* 2001). Dogs often accompanied the hunters on their expeditions, and hunting occurred at the individual, small group, or communal level (Pohl 1985; White *et al.* 2001). It has also been speculated that deer were penned outside of large centres, kept for sacrifical use and possibly even raised in households (Carr 1985; White *et al.* 2001), but significant archaeological evidence to support this hypothesis remains to be discovered (White *et al.* 2001).

Pohl (1990:157,158) noted that butchery and skinning marks are rare in Maya faunal samples, and that white-tailed deer provided the most evidence of butchering practices. Cutmarks have been located on the following deer elements: phalanges, metapodials, frontal bones (at the base of the antlers), vertebrae, mandibles, astragali, calcanei, humeri, radii, and ulnae. Pohl (1990:158) also described the rare occurrence of charred deer bones. However, she noted that when charred bones are recovered, they are represented by a relatively high frequency of mandibles and antlers, which may suggest roasting of the head, a practice seen in the Peten region today. She also speculated that large pieces of deer meat may have been cooked in the *pib*, the traditional Maya cooking pit (Pohl 1990:158).

In addition to the procurement and processing strategies employed in the exploitation of deer, it is important to examine the contribution of this animal to the diets of the prehistoric Maya. Dietary analysis is a relatively recent topic of study in Maya archaeology. It involves the comparison of the floral and faunal remains recovered from the archaeological record to the signatures of these remains (stable carbon and nitrogen isotopes) in the human skeletal material also recovered from the archaeological record. Such studies have been published by White and Schwarcz (1989), Clutton-Brock and Hammond (1994), Tykot *et al.* (1996), Gerry and Krueger (1997), Wright (1997), Coyston *et al.* (1999), Powis *et al.* (1999), and van der Merwe *et al.* (2000).

The results of dietary analyses are very site-specific, and often differ between individuals within the same site. Some regional studies have been conducted in effort to determine dietary changes over time (Gerry and Krueger 1997; Wright 1997; Coyston *et al.* 1999), while others have focused on dietary changes at a single site (White and Schwarcz 1989 at Lamanai; Clutton-Brock and Hammond 1994, Tykot *et al.* 1996, and van der Merwe *et al.* 2000 at Cuello; Powis *et al.* 1999 at Cahal Pech).

The contribution of deer to ancient Maya diet has been considered in many of the isotopic analyses that have been conducted to date however, the difficulty in distinguishing deer from other wild terrestrial C3 consuming-game has been noted. C3 is an abbreviation used to describe plants that produce a three-carbon atom molecule during the first stage of photosynthesis. The most common C3 plants include: wheat, rice, vegetables, root crops, and nuts (Ambrose 1993). There are also plants described as C4 plants (i.e. corn, millet, and sugar cane) as they produce a four-carbon atom molecule during the first stage of photosynthesis. It is important to distinguish between C3 and C4 plants when conducting dietary analyses (Ambrose 1993).

Although isotopic analyses may provide data on the types of plants and animals consumed by the ancient Maya, they do not provide specific data on the amount of plant matter or meat (in grams) consumed by individuals belonging to different social classes and within community or family settings. Even the archaeological record cannot shed much light on this area, as the poor preservation of faunal remains in Mesoamerica further complicates the examination of the role of this animal in prehistoric Maya subsistence economy. Perhaps future archaeological investigations will attempt to incorporate these factors into their research foci.

TURTLES

The procurement methods employed by the ancient Maya in their exploitation of various turtle species are not well recorded in either their writings or in ethnohistoric accounts. It has been speculated that turtles and their eggs were gathered by hand and that dragnets may also have been employed (Hamblin 1984). Clutton-Brock and Hammond (1994:820) proposed the possibility of turtle penning in artificial canals, which would have provided a controlled protein source, however, this idea remains to be explored. Pohl (1990) described Pope and Dahlin's (1989) observation of the firing of sawgrass in swampy areas to procure turtles in present-day Chiapas, and hypothesized the utilization of this method by the prehistoric Maya.

Landa (1566:192) noted the presence of large turtles that "are good eating and have plenty of flesh." These were most likely the green sea turtles found off the coast of Cozumel Island that were highly valued for their flavour, and that were the preferred soup turtle of the ancient Maya (Hamblin 1984). Due to the high frequency of burned turtle elements recovered on Cozumel Island, Hamblin (1984) speculated that turtles were also prepared by roasting them in their shells directly over the fire or on hot coals. She noted that the exploitation of turtles on Cozumel Island was a widespread cultural pattern, and one that is still seen today in subsistence economies throughout Latin America.

The contribution of turtles to the ancient Maya diet has also been considered in isotopic and quantitative faunal analyses. For the same reasons noted for deer, relatively little data have been produced on the role of turtles in the subsistence economy of the prehistoric Maya. This is yet another area in need of further examination.

DOGS

As discussed earlier, ancient Maya writings, artwork, and ceramics as well as the archaeological record illustrate the presence of dogs in Mesoamerica beginning in early Preclassic times. The introduction of the dog to this area of the Americas is not precisely known, but archaeological evidence indicates that the Maya rapidly adopted this animal. Dogs were raised in Maya households, and, when greater numbers were present than could be tolerated in the house, they were kept in pits outside (Pohl and Feldman 1982).

Dogs provided a reliable source of protein for the prehistoric Maya. Relatively little effort was required to maintain the dog population at a reasonable level: dogs could scavenge for food or consume leftovers and were reproductively self-sufficient. As noted for deer, relatively little evidence of butchery and skinning practices of dogs for subsistence purposes have been identified in the Maya faunal record. Hamblin (1984) noted a scarcity of burned dog elements in the Cozumel Island sample, which indicates that dogs were not being roasted over the fire, but perhaps stewed instead. Clutton-Brock and Hammond (1994:821) speculated that the highly fragmented nature of the dog remains recovered from Preclassic Cuello could be due to the practice of marrow extraction.

Recent studies have focused on the contribution of dogs to ancient Maya diet, as well as the degree of domestication of dogs. In their study of the dog remains from the Preclassic deposits at Cuello, Clutton-Brock and Hammond (1994) illustrated that dogs were raised for food and killed at the end of their first year of life. It was concluded that the Cuello dogs provided a significant, but not dominant, component of animal protein throughout the Preclassic period.

White *et al.* (2001) conducted a study on the Preclassic use of dogs at Colha. Stable carbon and nitrogen isotopic analyses indicated that dogs found in midden contexts had a mixed diet of C3 and C4 plants that became increasingly homogeneous, more enriched in C4 plants, and more herbivorous throughout the period. This indicates an increased dependence on humans for food products, and may also aid in identifying shifting human subsistence trends. Dogs found in cache or burial contexts have illustrated highly herbivorous, C4 diets, indicating purposeful feeding for ceremonial uses.

SUMMARY

This section has attempted to provide information on the procurement and processing methods and subsistence economy of the prehistoric Maya in relation to deer, turtles, and dogs. It was noted that deer were hunted using a variety of methods (nets, blowguns, spears and atlatls, snares, and deadfall pits) and possibly held captive in large pens outside of major city centres. Deer bones recovered from archaeological sites have multiple cutmarks, which are indicative of processing, while many

antlers and cranial bones show evidence of charring.

Archaeological and ethnographic data provided evidence that turtles and their eggs were collected by hand and by nets, also noting the possibility that turtle penning may have occurred in artificial canals. Turtle carapaces and elements recovered from Mayan sites demonstrated a high degree of charring, due to the roasting of turtles over fires or hot coals. It has also been speculated that turtles were boiled and prepared in soups.

Dog remains have been prevalent in Mesoamerica since the Preclassic period. It was noted that dogs were raised in Maya households and most-likely stewed for consumption. Several archaeological sites displayed a high number of fragmented dog bones. It was speculated that this pattern is associated with marrow-extraction.

The results from several isotopic analyses appear to be confounded by data limitations. These include: the inability to distinguish between animals with similar diets, the amount of plant and animal matter consumed by different social classes, and the poor preservation of human and faunal remains. This is clearly an area in need of further isotopic and archaeological examination. Only after these analyses have been conducted will the contribution of deer, turtles, and dogs to the prehistoric Maya subsistence economy be known.

THE SPATIAL AND TEMPORAL SIGNIFICANCE OF DEER, TURTLES, AND DOGS IN THE ANCIENT MAYA WORLD

METHODOLOGY

The focus of this section is to determine if there are any trends in ancient Maya subsistence, ceremonial, and ritual use of deer, turtles, and dogs at inland versus coastal sites from the Preclassic to Postclassic periods. In order to conduct this analysis, it was necessary to minimize the number of variables being considered. Thus, only the data for the white-tailed deer (*Odocoileus virginianus*) were analyzed for the deer group. In addition, all of the data from the five turtle families were pooled into a single turtle category. Similarly, the data from the inland sites were pooled and the data from the coastal sites were also pooled for the spatial analysis (refer to Table 1 for classification of inland versus coastal sites). Dog data were not modified.

To reduce confusion in the temporal analysis, all of the data were pooled into one of three categories: Preclassic, Classic, and Postclassic (Figure 6). The sites included in each of these temporal categories are listed in Table 3, according to geographic location.

As previously discussed, not all of the frequencies for the deer, turtle, and dog remains recovered from the archaeological sites in this study were reported in the same manner. Some of the frequencies were reported as NISP while other frequencies were reported as MNI. In effort to utilize all of the collected data, the spatial and temporal relationships of ancient Maya use of deer, turtles, and dogs were examined using both NISP and MNI. Table 4 presents the grouping of the data. From this table, it should be noted that some sites were used in both analyses (i.e. Altar de Sacrificios, Seibal, Tikal, Cuello, and Cozumel Island), while others were only used in either analyses of NISP (i.e. Cahal Pech and Colha) or analyses of MNI (i.e. Tipu, Lamanai, and Dzibilchaltun). This should be kept in mind during the interpretation of the frequency data. Table 5 summarizes the site location, temporal periods represented, and the animal frequency types for the ten archaeological sites examined in this study.

The chi-square statistic was employed in the analyses of the data. Both chi-square contingency tables and one-way tables (McClave and Sincich 2000) were utilized to examine the association of geographic region (inland vs. coastal) to temporal period (Preclassic, Classic, Postclassic), as well as to examine the distribution of animal types within regions and over time.

TABLE 3: TEMPORAL AND GEOGRAPHIC DISTRIBUTION OF ARCHAEOLOGICAL SITES

LOCAL	PRECLASSIC PERIOD	CLASSIC PERIOD	POSTCLASSIC PERIOD
INLAND	Altar de Sacrificios Cahal Pech Seibal	Altar de Sacrificios Seibal	Tikal Tipu Lamanai
COASTAL	Colha Cuello Dzibilchaltun	Dzibilchaltun Cozumel Island	Cozumel Island

TABLE 4: SITES ACCORDING TO TYPE OF ANIMAL FREQUENCY COUNT (NISP vs MNI) AND GEOGRAPHIC LOCATION (INLAND vs COASTAL)

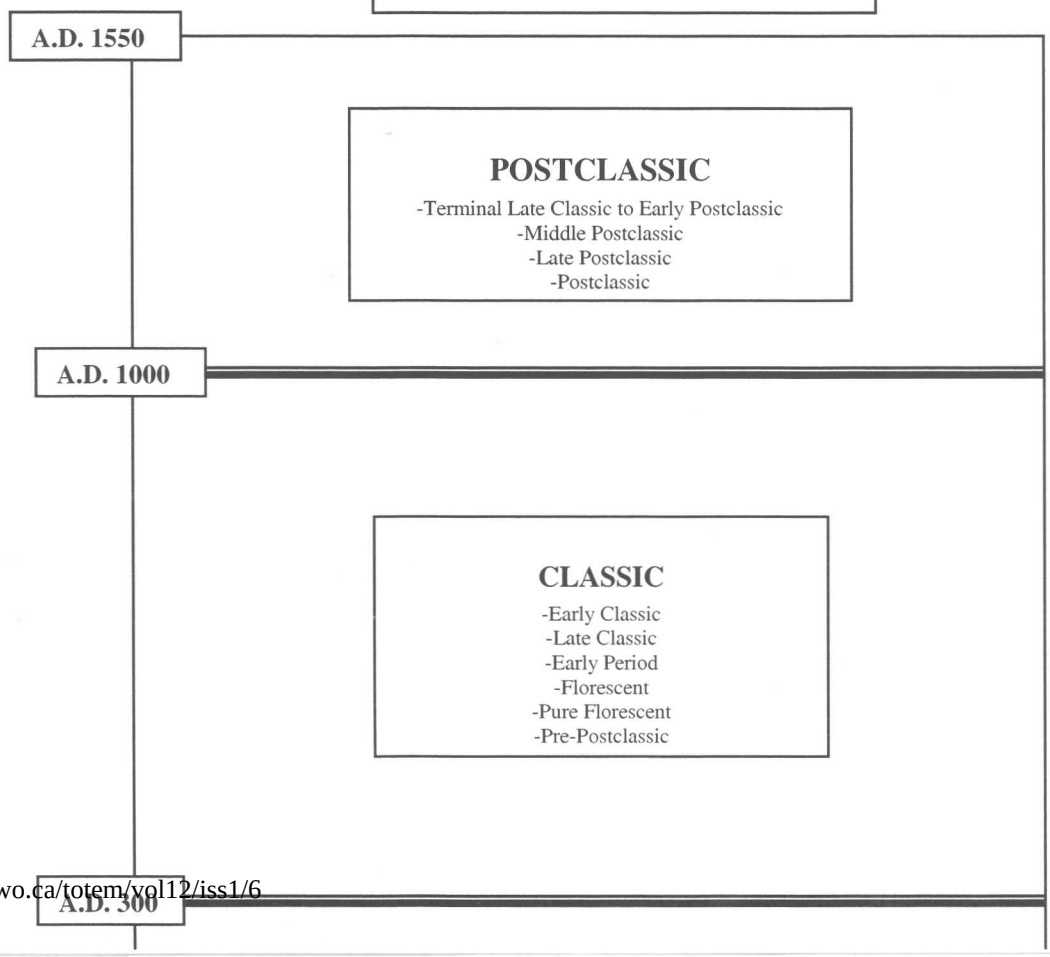
LOCATION	NISP	MNI
INLAND	Altar de Sacrificios Seibal	Altar de Sacrificios Seibal

	Tikal Cahal Pech	Tikal Tipu Lamanai
COASTAL	Cuello Cozumel Island Colha	Cuello Cozumel Island Dzibilchaltun

TABLE 5: SUMMARY OF SITE LOCATION, TEMPORAL PERIOD, AND TYPE OF ANIMAL FREQUENCY COUNT

SITE	LOCAL	PERIOD	COUNT TYPE	SOURCE
Altar de Sacrificios	Inland	Preclassic Classic	NISP MNI	Pohl 1990: 150,151
Cahal Pech	Inland	Preclassic	NISP	Stanchly 1995: 133,135
Lamani	Inland	Postclassic	MNI	Emery 1999: 67
Seibal	Inland	Preclassic Classic	NISP MNI	Pohl 1990:150,151
Tikal	Inland	Postclassic	NISP MNI	Pohl 1990: 150,151
Tipu	Inland	Postclassic	MNI	Emery 1999: 68, 69
Colha	Coastal	Preclassic	NISP	Shaw 1999: 89, 90
Cozumel Island	Coastal	Classic Postclassic	NISP MNI	Hamblin 1984: 61, 67, 101, 120, 138, 142
Cuello	Coastal	Preclassic	NISP MNI	Wing and Scudder 1991: 88-95
Dzibilchaltun	Coastal	Preclassic Classic	MNI	Wing and Steadman 1980:

FIGURE 6: Timeline for distribution of sites



RESULTS AND DISCUSSION

The results of the data compilation are presented in the following NISP and MNI frequency data tables (Tables 6 and 7).

The data in these tables were first examined using chi-square (χ^2) contingency tables to determine if there was an association between geographic location (i.e. inland or coastal sites) and temporal period (the Preclassic, Classic, and Postclassic periods) for each animal type. The null hypothesis (H_o) assumed that the geographic location and the temporal period are independent of one another (i.e. there is no association between the two). The results and conclusions of these calculations are listed in Table 8.

The results of these analyses clearly illustrate that for all animal types and for both types of frequency counts at the $\alpha = 0.05$ significance level, there is an association between geographic location and temporal period, that is, geographic location and temporal period are not independent of one another. This is supported by the rejection of the null hypothesis in every case. It was thus necessary to further explore the nature of this association.

Several one-dimensional χ^2 analyses were conducted. The first of these examined the relationship between geographic location and animal type frequency. The null hypothesis (H_o) assumed that the animal type frequencies found at inland sites did not differ from the animal type frequencies found at coastal sites, irrespective of time period (i.e. temporal periods combined). The results of these analyses are listed in Table 9. At the $\alpha = 0.05$ significance level, the null hypothesis is rejected for each animal type in both NISP and MNI counts. Therefore, there appears to be a difference in the distribution of each animal type between inland and coastal sites.The next test examined the relationship between animal type frequency and temporal period. The null hypothesis assumed that the frequency of animal type was the same for each of the temporal periods examined, irrespective of region (i.e. inland and coastal sites combined). The results of this analysis for both NISP and MNI are presented in Table 10. From this table, it may be noted that the null hypothesis is rejected at the $\alpha = 0.05$ significance level in every case except for the MNI for white-tailed deer. Re-examining the data in Table 7, it can be noted that the MNI frequency for white-tailed deer is relatively consistent over time, which would explain why the null hypothesis failed to be rejected. Therefore, with the exception of MNI for white-tailed deer, there appears to be a difference in the distribution of animal types during the Preclassic, Classic, and Postclassic periods.

An examination of the frequency of animal type by geographic location during the three temporal periods was the next task. The first null hypothesis assumed that animal type frequency remained the same at inland sites from the Preclassic to the Postclassic periods. In every case but one, the MNI for dogs, the null hypothesis was rejected at the $\alpha = 0.05$ significance level (Table 11). Referring back to Table 7, it is noted that the MNI frequency of dog remains does not greatly differ between the Preclassic, Classic, and Postclassic periods. This explains why the null hypothesis failed to be rejected.

The second null hypothesis assumed that animal type frequency remained the same at coastal sites from the Preclassic to the Postclassic periods. Table 12 illustrates that in every case, the null hypothesis was rejected at the $\alpha = 0.05$ significance level. Therefore, with the exception of MNI for dogs at inland sites, there appears to be a difference in the distribution of animal types at inland and coastal sites during the Preclassic, Classic, and Postclassic periods.

The last set of tests explored the changes in animal type frequency by geographic location within each of the three temporal periods. The first null hypothesis assumed that animal type frequency was the same at inland and coastal sites during the Preclassic period. Table 13 presents the results of this test. In every case, the null hypothesis was rejected at the $\alpha = 0.05$ significance level.

The second null hypothesis assumed that animal type frequency was the same at inland and coastal sites during the Classic period. In examining Table 14, it is noted that the null hypothesis failed to be rejected in three cases: the MNI frequency for turtle and both the NISP and MNI frequencies for dog. Upon re-examination of Tables 6 and 7, it may be noted that MNI frequency for turtles, and the NISP and MNI frequencies for dogs at inland and coastal sites during this period do not greatly differ. This explains why the null hypothesis failed to be rejected.

TABLE 6: NISP FREQUENCY FOR WHITE-TAILED DEER, TURTLE, AND DOG AT INLAND VERSUS COASTAL SITES FROM THE PRECLASSIC TO THE POSTCLASSIC PERIODS

	TIME PERIOD			
ANIMAL/REGION	**PRECLASSIC**	**CLASSIC**	**POSTCLASSIC**	**TOTAL**
WHITE-TAILED DEER				
INLAND	92	328	39	**459**
COASTAL	711	1	11	**723**
TOTAL	**803**	**329**	**50**	**1182**
TURTLE				
INLAND	43	234	5	**282**
COASTAL	1938	317	1261	**3516**
TOTAL	**1981**	**551**	**1266**	**3798**
DOG				
INLAND	14	23	1	**38**
COASTAL	563	13	515	**1091**
TOTAL	**577**	**36**	**516**	**1129**

TABLE 7: MNI FREQUENCY FOR WHITE-TAILED DEER, TURTLE, AND DOG AT INLAND VERSUS COASTAL SITES FROM THE PRECLASSIC TO THE POSTCLASSIC PERIODS

	TIME PERIOD			
ANIMAL/ REGION	**PRECLASSIC**	**CLASSIC**	**POSTCLASSIC**	**TOTAL**
WHITE-TAILED DEER				
INLAND	3	31	46	**80**
COASTAL	41	16	0	**57**
TOTAL	**44**	**47**	**46**	**137**
TURTLE				
INLAND	10	25	18	**53**
COASTAL	60	29	228	**317**
TOTAL	**70**	**54**	**246**	**370**
DOG				
INLAND	5	6	13	**24**
COASTAL	37	5	69	**111**
TOTAL	**42**	**11**	**82**	**135**

TABLE 8: TESTING THE INDEPENDENCE BETWEEN REGION AND TEMPORAL PERIOD

FREQUENCY COUNT	ANIMAL	CALCULATED χ^2 VALUE	CONCLUSION
NISP	**WHITE-TAILED DEER**	798.73	H_0 rejected
	TURTLE	1154.99	H_0 rejected
	DOG	422.97	H_0 rejected
MNI	**WHITE-TAILED DEER**	82.06	H_0 rejected
	TURTLE	54.82	H_0 rejected
	DOG	11.37	H_0 rejected

NOTE: $\alpha = 0.05$ with df=2, where $\chi^2_{0.05} = 5.99147$

TABLE 9: A COMPARISON OF ANIMAL TYPE FREQUENCIES AT INLAND AND COASTAL SITES IRRESPECTIVE OF TIME PERIOD

ANIMAL/FREQUENCY	CALCULATED χ^2 VALUE	CONCLUSION
WHITE-TAILED DEER		
NISP	58.96	H_0 rejected
MNI	3.86	H_0 rejected
TURTLE		
NISP	2753.75	H_0 rejected
MNI	188.37	H_0 rejected
DOG		
NISP	982.12	H_0 rejected
MNI	56.07	H_0 rejected

NOTE: $\alpha = 0.05$ with df=1, where $\chi^2_{0.05} = 3.84146$

TABLE 10: A COMPARISON OF ANIMAL TYPE FREQUENCY TO TEMPORAL PERIOD IRRESPECTIVE OF REGION

ANIMAL/FREQUENCY	CALCULATED χ^2 VALUE	CONCLUSION
WHITE-TAILED DEER		
NISP	735.64	H_0 rejected
MNI	0.10	Fail to reject H_0
TURTLE		
NISP	807.62	H_0 rejected
MNI	184.04	H_0 rejected
DOG		
NISP	466.61	H_0 rejected
MNI	56.31	H_0 rejected

NOTE: $\alpha = 0.05$ with df=2, where $\chi^2_{0.05} = 5.99147$

TABLE 11: A COMPARISON OF ANIMAL TYPE FREQUENCY AT INLAND SITES OVER ALL THREE TEMPORAL PERIODS

ANIMAL/FREQUENCY	CALCULATED χ^2 VALUE	CONCLUSION
WHITE-TAILED DEER		
NISP	309.42	H_0 rejected
MNI	35.73	H_0 rejected
TURTLE		
NISP	320.45	H_0 rejected
MNI	6.38	H_0 rejected
DOG		
NISP	19.32	H_0 rejected
MNI	4.75	Fail to reject H_0

NOTE: $\alpha = 0.05$ with df=2, where $X^2_{0.05} = 5.99147$

TABLE 12: A COMPARISON OF ANIMAL TYPE FREQUENCY AT COASTAL SITES OVER ALL THREE TEMPORAL PERIODS

ANIMAL/FREQUENCY	CALCULATED χ^2 VALUE	CONCLUSION
WHITE-TAILED DEER		
NISP	1375.10	H_0 rejected
MNI	44.95	H_0 rejected
TURTLE		
NISP	1131.15	H_0 rejected
MNI	216.99	H_0 rejected
DOG		
NISP	510.36	H_0 rejected
MNI	55.35	H_0 rejected

NOTE: $\alpha = 0.05$ with df=2, where $\chi^2_{0.05} = 5.99147$

TABLE 13: A COMPARISON OF ANIMAL TYPE FREQUENCY AND REGION DURING THE PRECLASSIC PERIOD

ANIMAL/FREQUENCY	CALCULATED χ^2 VALUE	CONCLUSION
WHITE-TAILED DEER		
NISP	477.16	H_0 rejected
MNI	32.82	H_0 rejected
TURTLE		
NISP	1812.73	H_0 rejected
MNI	35.71	H_0 rejected
DOG		
NISP	522.36	H_0 rejected
MNI	24.38	H_0 rejected

NOTE: $\alpha = 0.05$ with df=1, where $\chi^2_{0.05} = 3.84146$

The third null hypothesis assumed that animal type frequency was the same at inland and coastal sites during the Postclassic period. Table 15 presents the results of this test. In every case, the null hypothesis was rejected at the $\alpha = 0.05$ significance level.

From these results, one may conclude that during the Preclassic and Postclassic periods, there is a difference in the distribution of animal types by inland and coastal regions. During the Classic period, there appears to be a difference in the distribution of animal types by inland and coastal region for all cases but the MNI frequency for turtle and the NISP and MNI frequencies for dog, which remain relatively constant at inland and coastal sites during this period.

SUMMARY

Detailed statistical analyses of the NISP and the MNI recovered from the inland sites of Altar de Sacrificios, Seibal, Tikal, Cahal Pech, Tipu, and Lamanai and the coastal sites of Cuello, Colha, Cozumel Island, and Dzibilchaltun during the Preclassic, Classic, and Postclassic periods were conducted. Using chi-square contingency tables, an association between the spatial and temporal distribution of deer, turtles, and dogs in the Maya realm was demonstrated. Further analyses using one-dimensional chi-square tables provided interesting insights into ancient Maya use of these animals. The outcomes of these tests are presented in Table 16.

These results indicate that the use of deer, turtles, and dogs by the ancient Maya varied according to both geographic region and temporal period. The next task is to determine the specific trends in the interactions between these animal types and the prehistoric Maya, a task that requires a much larger database, one that may be available in the near future.

In this study, statistical analyses of the NISP and MNI frequencies for deer, turtles, and dogs appear to provide the same general conclusions about the spatial and temporal relationships of these animals in the ancient Maya world. Some discrepancies do occur, however, and must be examined in light of the small sample size and the fact that different sites are represented in these two types of frequency counts. It is beyond the scope of this paper to assess which one of these frequency counts best represents the data, but perhaps future studies may attempt to examine this factor. Also, further analyses using other statistics, such as the G-statistic, may provide greater insight into the spatial and temporal significance of deer, turtles, and dogs in the world of the ancient Maya.

CONCLUSIONS AND DIRECTIONS FOR FUTURE RESEARCH

The purpose of this paper was to examine the human-faunal interactions between the ancient Maya and deer, turtles, and dogs. Maya codices, ritual books, ceramics and artwork, as well as ethnohistoric accounts and evidence from the archaeological record, have illustrated the symbolic, ritual, and ceremonial significance of these animals in the Maya world.

Ethnohistoric and ethnographic resources, prehistoric Maya artwork and ceramics, and the archaeological record have provided information on the procurement and processing methods of deer, turtles, and dogs, and their role in the subsistence economy of the ancient Maya. It is clear that these three animal types were consumed in different proportions by the ancient Maya over time, but the contribution of each to the diet of individuals or family groups residing at specific sites or within specific regions remains to be defined. This is an area in need of further research.

The results of the statistical analyses of the ten selected Mayan sites strongly indicate that the utilization of deer, turtles and dogs varied between inland and coastal sites and during the Preclassic, Classic, and Postclassic periods, with the few exceptions noted above. The availability of these three animal types would have differed with site location (i.e. inland versus coastal), which is characterized by one or more different types of ecosystems (i.e. tropical rainforest versus wetland). The availability of deer, turtles and dogs would also have differed from one temporal period to the next. Factors such as humidity, precipitation, sunlight, and human exploitation greatly influence the survival of plant and animal species, and can be traced over long time periods. The continual occupation of Mesoamerica by the Maya permits detailed examinations of these changes over three millenia.

The small dataset employed in this study prevents the identification of specific trends in the utilization of deer, turtles, and dogs by the ancient Maya. The faunal remains recovered from the archaeological record are subjected to preservation and recovery biases. As such, it is difficult to estimate the "real" NISP

TABLE 14: A COMPARISON OF ANIMAL TYPE FREQUENCY AND REGION DURING THE CLASSIC PERIOD

ANIMAL/FREQUENCY	CALCULATED χ^2 VALUE	CONCLUSION
WHITE-TAILED DEER		
NISP	325.01	H_0 rejected
MNI	4.79	H_0 rejected
TURTLE		
NISP	12.50	H_0 rejected
MNI	0.30	Fail to reject H_0
DOG		
NISP	2.78	Fail to reject H_0
MNI	0.09	Fail to reject H_0

NOTE: $\alpha = 0.05$ with df=1, where $\chi^2_{0.05} = 3.84146$

TABLE 15: A COMPARISON OF ANIMAL TYPE FREQUENCY AND REGION DURING THE POSTCLASSIC PERIOD

ANIMAL/FREQUENCY	CALCULATED χ^2 VALUE	CONCLUSION
WHITE-TAILED DEER		
NISP	15.68	H_0 rejected
MNI	46.00	H_0 rejected
TURTLE		
NISP	1246.08	H_0 rejected
MNI	179.27	H_0 rejected
DOG		
NISP	512.01	H_0 rejected
MNI	38.24	H_0 rejected

NOTE: $\alpha = 0.05$ with df=1, where $\chi^2_{0.05} = 3.84146$

TABLE 16: OUTCOMES OF STATISTICAL ANALYSES CONDUCTED IN THIS STUDY

TABLE	RELATIONSHIP EXAMINED	OUTCOMES
9	-animal type frequency at inland versus coastal sites irrespective of temporal period (i.e. temporal periods combined)	-there is a difference in the representation of deer, turtles, and dogs between inland and coastal sites
10	-animal type frequency within the three temporal periods irrespective of geographic location (i.e. inland and coastal regions combined)	-there is a difference in the representation of deer, turtles, and dogs during the Preclassic, Classic, and Postclassic periods -there is, however, one exception, the MNI for deer, which remains constant over time
11	-animal type frequency at inland sites from the Preclassic to Postclassic periods	-there is a difference in the representation of deer, turtles, and dogs at inland sites during the Preclassic, Classic, and Postclassic periods -there is, however, one exception, the MNI for dogs, which remains constant over time
12	-animal type frequency at coastal sites from the Preclassic to Postclassic periods	-there is a difference in the representation of deer, turtles, and dogs at coastal sites during the Preclassic, Classic, and Postclassic periods
13	-animal type frequency at inland versus coastal sites during the Preclassic period	-there is a difference in the representation of deer, turtles, and dogs between inland and coastal sites during the Preclassic period
14	-animal type frequency at inland versus coastal sites during the Classic period	-there is a difference in the representation of deer, turtles, and dogs between inland and coastal sites during the Classic period -there are, however, three exceptions, the MNI for turtles and the MNI and NISP for dogs -these values do not greatly differ between inland and coastal sites during the Classic period
15	-animal type frequency at inland versus coastal sites during the Postclassic period	-there is a difference in the representation of deer, turtles, and dogs between inland and coastal sites during the Postclassic period

and MNI values and hence the importance of a single species or groups of species within ancient Maya ceremonial and/or dietary practises.

During the research and writing of this paper, the lack of availability of faunal data and the inconsistent nature of the reporting of this data was a perpetual setback. Therefore, a standard for faunal data presentation should be developed for future reports to follow. Also, the majority of the studies of faunal remains recovered from Mesoamerica have been presented in the form of Master's theses and PhD dissertations, resources that aren't always easily accessible. The information presented in these resources clearly needs to be available to a larger research body. Perhaps then we will be better able to examine and understand the human-faunal interactions of the ancient Maya world.

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